Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2017/017

Quebec Region

Proceedings of the regional peer review meeting on the Assessment of the Estuary and Gulf of St. Lawrence Shrimp Stocks

January 21, 2016
Mont-Joli, Quebec

Chairperson: Stéphane Plourde
Rapporteur: Sonia Dubé

Maurice Lamontagne Institute
Fisheries and Oceans Canada
850 Route de la Mer, P.O. Box 1000
Mont-Joli, Quebec G5H 3Z4

May 2017

Canada

Foreword

The purpose of these proceedings is to document the key activities and discussions of the meeting. The proceedings may include research recommendations, uncertainties and the rationale for decisions made during the meeting. They may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. Therefore, interpretations and opinions presented in this report may be factually incorrect or misleading, but are included to record, as faithfully as possible, what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available within the time frame of the meeting. In the rare case when there are formal dissenting views, these are also archived as Appendices to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa, ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

© Her Majesty the Queen in Right of Canada, 2017
ISSN 1701-1280

Correct citation for this publication:

DFO. 2017. Proceedings of the regional peer review meeting on the Assessment of the Estuary and Gulf of St. Lawrence Shrimp Stocks; January 21, 2016. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2017/017.

Aussi disponible en français :

MPO. 2017. Compte rendu de l'examen régional par des pairs sur l'évaluation des stocks de crevette de l'estuaire et du golfe du Saint-Laurent; le 21 janvier 2016. Secr. can. de consult. sci. du MPO, Compte rendu 2017/017.

SUMMARY

This document contains the proceedings from the meeting held within the regional assessment process of the Estuary and Gulf of St. Lawrence Shrimp Stocks. This review process was held on January 21, 2016, at the Maurice Lamontagne Institute in Mont-Joli. This meeting gathered about forty participants from sciences, management and industry. This proceeding contains the essential parts of the presentations and discussions held and relates the recommendations and conclusions that were presented during the review.

SOMMAIRE

Ce document renferme le compte rendu de la réunion tenue dans le cadre du processus régional d'évaluation des stocks de crevette de l'estuaire et du golfe du Saint-Laurent. Cette revue, qui s'est déroulée le 21 janvier 2016 à l'Institut Maurice-Lamontagne à Mont-Joli, a réuni une quarantaine de participants des sciences, de la gestion et de l'industrie. Ce compte rendu contient l'essentiel des présentations et des discussions qui ont eu lieu pendant la réunion et fait état des recommandations et conclusions émises au moment de la revue.

INTRODUCTION

The Quebec Region of Fisheries and Oceans Canada (DFO) is responsible for assessing the stocks of several exploited fish and invertebrate species in the Estuary and Gulf of St. Lawrence. Most of these stocks are assessed periodically within a regional advisory process, which is conducted at the Maurice Lamontagne Institute in Mont-Joli. This document consists of the proceedings of the meeting held on January 21, 2016, on the assessment of the Estuary and Gulf of St. Lawrence shrimp stocks.

The objective of the meeting was to determine whether there were any changes in the resource's status and whether adjustments were required to the management plans based on the chosen conservation approach, the ultimate goal being to provide scientific advice on managing the shrimp stock in the Estuary and Gulf of St. Lawrence for the 2016 fishing season.

These proceedings report on the main points discussed in the presentations and deliberations stemming from the activities of the regional stock assessment committee. The regional review is a process open to all participants who are able to provide a critical outlook on the status of the assessed resources. Accordingly, participants from outside DFO are invited to take part in the committee's activities within the defined framework for this review (Appendices 1 and 2). The proceedings also list the recommendations made by the meeting participants.

BACKGROUND

Meeting chairperson Stéphane Plourde welcomes the participants. He goes over the scientific review's objectives and agenda. After the participants introduce themselves, the biologist in charge of the review, Hugo Bourdages, highlights the contribution of his collaborators. He describes the meeting plan and the Terms of Reference. This review will be used to provide scientific advice for the 2016 fishing season.

A synopsis of the fishery management measures is given. There are four fishing areas (Estuary, Sept-Iles, Anticosti and Esquiman) and 115 licences (five provinces and seven First Nations). Each area is subject to catch monitoring through the application of a total allowable catch (TAC). A history of the shrimp life cycle is also presented to show the harvesting periods based on development stages. The data used in the assessment come from the commercial fishery (1982–2016) and the DFO research survey (1990–2016).

ECOSYSTEM CONSIDERATIONS

Before getting to the heart of the matter, Mr. Bourdages reviews some ecosystem considerations for shrimp. The temperature profile of the bottom of the Gulf of St. Lawrence shows that the average temperature at depths of 150 to 300 m reached a record high temperature in 2015, and for the first time in 2015, the temperature exceeded 6°C at 250 and 300 m. The area of seafloor with temperatures warmer than 6°C also increased in 2015 in the Anticosti and Esquiman channels and in the centre of the Gulf to the detriment of seafloor habitat in the 5 to 6°C temperature range. In 2015, male and female shrimp were found at bottom temperatures that were 1°C warmer compared to the 1990 to 2014 average.

Despite these changes, shrimp distribution is noted to be at the same depths. Although the median temperature where shrimp were found from 1990 to 2014 was 5.2°C, shrimp seem to tolerate the current warming. The participants are wondering whether shrimp can acclimatize to a gradual warming.

Although maturation and spawning take place later and later in the fall, the hatching period has been noted to remain stable in the spring. Since eggs develop faster in warmer water, the hypothesis is that shrimp adjust their spawning period to ensure a "good match" with the phytoplankton bloom. Other participants suggest instead that there might be an additional moult, which would explain the spawning delay. It would be interesting to examine whether there has been a greater gain in summer size in recent years.

Stéphane Plourde presents a model to describe the effect of (physical and biological) environmental variations on the Northern Shrimp stock. The main conclusions arising from this work are as follows: (1) variations in physical oceanographic conditions and zooplankton dynamics are observed at different time scales; (2) variations in zooplankton dynamics have a dominant effect on the success of Northern Shrimp recruitment; and (3) various environmental regimes (periods) and stock recruitment successes are noted.

There seems to be a real interest in the "predictive power" of this model, which highlights (physical and biological) environmental conditions suitable for the recruitment of juveniles. It is noted that information on juvenile predation would be very complementary.

According to one comment, the Sept-Iles and Anticosti areas cannot be compared because the variables used are different.

Participants are wondering about the survival time of shrimp larvae in the absence of zooplankton. At a temperature of 3 to 5°C, survival would be about 10 days. It seems, however, that larvae could also feed on phytoplankton.

Denis Chabot's presentation deals with the potential impact of hypoxia on Northern Shrimp. Lower dissolved oxygen levels have been observed at the heads of channels. Since animals derive their energy from oxygen, conditions of hypoxia can have an impact on, among other things, food consumption (slower digestion) and growth. At 5°C, the critical (lethal) threshold is 9% saturation for males and 15.5% saturation for females. This threshold is higher in warmer water.

It seems that current conditions are still far from the lethal threshold, except in the Estuary in waters deeper than 175 m, where levels range from 18 to 25%. The assumption is that the current level does not affect shrimp growth and production.

However, given the warming, which could increase shrimp metabolism and lead to greater oxygen consumption, longer-term effects are difficult to predict.

Changes in environmental and ecosystem conditions have been observed throughout the Gulf of St. Lawrence. The bottom temperature is warming up and the abundance of groundfish is increasing. These changes may have an impact on shrimp population dynamics through, among other things, effects on spatial distribution, growth, reproduction and trophic relationships.

ASSESSMENT OF THE RESOURCE

COMMERCIAL FISHERY

Mr. Bourdages presents the commercial fishing indicators (landings, effort, CPUE, distribution, length frequency) for each area. In 2015, preliminary landings totalled 30 367 t against a TAC of 31 549 t. The total fishing effort is stable and corresponds annually to a maximum seabed footprint of about 6 400 km^2. The same areas are fished by shrimp harvesters from one year to the next. The fishery's standardized catch rate in the four areas is high compared to the historical average. Over the past four years, the catch rate was stable in Estuary, up in Sept-Iles and Anticosti and down in Esquiman.

Industry members are wondering how to consider the increasing efficiency of the fishery. According to the biologist, this increase in efficiency has long-term effects. However, interannual variations would be related mainly to the resource.

Some changes are reported in the distribution of the fishing effort. In particular, there has been no fishing activity south of Anticosti since 2009. In addition, an increased effort was observed in the western part of the Estuary in 2015.

It is noted that Vessel Monitoring System (VMS) data provide more accurate information on the distribution of the fishing effort compared to logbooks. Among other things, these data are used to calculate the trawling footprint on the seabed.

As part of the Coral and Sponge Conservation Strategy for the Gulf, the distribution of various species was examined compared to the shrimp trawling footprint. A significant proportion of corals and sponges is located where there is no trawling.

As for Esquiman, one participant wants to ensure that an adequate number of samples from Newfoundland is taken into account, which, after some checking, looks to be the case.

The section of the Science Advisory Report on sources of uncertainty includes the presence of fixed gear in Esquiman, which led to a shift in fishing effort and the closure of grids in 2014.

RESEARCH SURVEY

Mr. Bourdages presents the DFO research survey indicators (distribution, biomass, abundance, length frequency) for each area. The biomass index from the survey in the Estuary decreased in 2015. In Sept-Iles and Anticosti, the indices decreased between 2007 and 2011 and remained stable thereafter. In Esquiman, the biomass index has decreased since 2011. Demographic structures show that abundance of males and females is near the historical average, with the exception of the Estuary area, where it has been below the average observed since 2008. This suggests recruitment to the fishery in the short term equal to the average.

- With regard to biomass distribution, the trend observed in the concentration could be associated with the dependence density phenomenon. Other participants would not underestimate the impact of warming.
- Significant differences are noted between the DFO survey and commercial fishing with regard to abundance indices for males and females.

EXPLOITATION RATE

The biologist presents an exploitation rate index (shrimp caught [n]/survey abundance [n]), which compares to the historical average, with the exception of Anticosti, where it is higher, but it has been trending downward toward the mean since 2011.

- The participants are reminded that a variation in TAC has an impact on the exploitation rate. Ideally, maintaining a relatively constant exploitation rate should be targeted. Despite an interannual variability in the TAC, it appears that it is being reached.

PRECAUTIONARY APPROACH

The methodology used for the precautionary approach is presented. The main indicator of stock status is calculated from the standardized indices of males and females in the summer fishery and the research survey. The main stock status indicator shows that the stocks were in the healthy zone in 2015. Over the past five years, the stock status indicator has remained

somewhat stable in the Estuary, Sept-Iles and Anticosti, whereas a downward trend has been observed in Esquiman.

- It is pointed out that the months from June to August are used to estimate the commercial fishing CPUE, since males and primiparous females will be available to the fishery the following season, which is a good indicator of the season that follows.
- Participants are wondering about the differences observed between the male and female standardized indices from the fishery and from the survey. The suggestion is to examine the spatial distribution of catches, area by area, to understand these differences better.
- In the SAR, it is important to clearly describe the different factors that could explain these differences (fishing patterns, catch techniques, standardization, etc.) and to refer to them in the sources of uncertainty.
- The precautionary approach typically favours the use of indices from fishery-independent surveys. Considering what was done in the past with respect to shrimp, it is also agreed to include fishery indices in the main stock status indicator. This approach appears to still be appropriate.

Reference points were determined and guidelines were established to determine catches based on the main stock status indicator and its position relative to the classification zones (healthy, cautious and critical).

- Mr. Bourdages indicates that the current decision rules were revised at the request of industry members, who want to limit interannual variations in TAC, which they feel are difficult to manage. Other rules were therefore explored (smoothing, thresholds and high ceilings).
- In conclusion, there is no perfect rule, but all the simulated rules meet the conservation objectives. The industry finally decided to continue with the current rule: the minimum threshold for a change in TAC between two years is 5% in the three areas. A cap of 15% variation is used in the healthy area only.

BYCATCHES

Mr. Bourdages gives an overview of bycatches in the shrimp fishery for Redfish, Greenland Halibut, Capelin and Atlantic Cod. Since 2013, bycatches have increased because of the significant rise in small redfish catches. From 2013 to 2015, bycatches accounted for 2.6%, 3.6% and 3.3% (in weight) of Northern Shrimp catches. Total catches estimated per species in these bycatches nonetheless represent less than 1.0% of biomass estimates in the DFO survey for each species.

- Industry members are wondering about the actual impact of the closure of grids (through the small fish protocol), particularly on small redfish. It seems that the cumulative effect of all of these protected areas is significant. In addition, with the arrival of new cohorts of Redfish after 30 years of absence, it is important to proceed with caution.
- This approach is deemed to be very much in line with the ecocertification approach of the shrimp fishery.

INTERIM YEARS

The Estuary and Gulf of St. Lawrence Northern Shrimp stock is reviewed every two years. For the interim years, an update of the following indices is planned:

- Landings
- Summer fishery CPUE (male and female)
- Abundance index from the survey (male and female)
- Main stock status indicator
- Projected harvest

RESEARCH

Mr. Bourdages cites a recent publication (2015)[1] and briefly outlines DFO contributions as part of the Northern Shrimp strategic research plan (Appendix 3).

WRAP-UP

SUMMARY

The highlights of the assessment are presented and the participants share their comments.

- The main discussion focuses on the highlight on demographic structures observed during the survey. A suggestion is made to add the provisional aspect that this highlight suggests, in other words, a recruitment to the fishery in the short term equal to the average.

RECOMMENDATION

Harvest guidelines were established according to the main indicator and its position in relation to the stock status classification zones (healthy, cautious and critical) in compliance with the precautionary approach. According to the guidelines, the projected harvest for 2016 is 1084 t for Estuary, 12 282 t for Sept-Iles, 9310 t for Anticosti and 6609 t for Esquiman.

TACs are set annually by fisheries management and are based on harvest projections calculated according to the decision rules in the precautionary approach in effect.

[1] Moritz, C., Gravel, D., Savard, L., McKindsey, C.W., Brêthes, J.-C., and Archambault, P. 2015. No more detectable fishing effect on Northern Gulf of St Lawrence benthic invertebrates. *ICES Journal of Marine Science*, 72: 2457–66.

APPENDIX 1 – LIST OF PARTICIPANTS

Name	Affiliation
Bernier, Denis	DFO – Science
Bourdages, Hugo	DFO – Science
Brassard, Claude	DFO – Science
Brulotte, Sylvie	DFO – Science
Bruneau, Benoît	DFO – Science
Chabot, Denis	DFO – Science
Côté, Mario	ACPG
Cotton, Dave	ACPG
Coulombe, Sylvio	DFO – Fisheries Management
Cyr, Charley	DFO – Science
Dallaire, Jean-Paul	DFO – Science
Desgagnés, Mathieu	DFO – Science
Dubé, Sonia	DFO – Science
Duplisea, Daniel	DFO – Science
Element, Patrice	ACPG
Gauvin, Réal	FRAPP
Giffin, Mélanie	PEIFA
Hardy, Magalie	DFO – Fisheries Management
Hurtubise, Sylvain	DFO – Science
Lambert, Jean	DFO – Science
Lambert, Yvan	DFO – Science
Lanteigne, Jean	FRAPP
Légaré, Benoît	DFO – Science
Le Mer, Charline	DFO – Science
Marquis, Marie-Claude	DFO – Science
Mélançon, Josiane	DFO – Science
Morin, Bernard	DFO – Fisheries Management
Nozères, Claude	DFO – Science
Ouellet, Patrick	DFO – Science
Paré, Sébastien	ACPG
Plourde, Stéphane	DFO – Science
Roussel, Eda	FRAPP/ACAG
Sainte-Marie, Bernard	DFO – Science
St-Pierre, Sylvie	DFO – Science
Sandt-Duguay, Emmanuel	AGHAMM
Savenkoft, Claude	DFO – Science
Schwab, Philippe	DFO – Science
Spingle, Jason	FFAW
Thériault, Stéphane	FRAPP
Thibeault, Sébastien	Nation Malécite
Trottier, Steve	DFO – Science
Von Beveren, Elisabeth	DFO – Science

APPENDIX 2 – TERMS OF REFERENCE

Assessment of Estuary and Gulf of St. Lawrence shrimp stocks

Regional Peer Review - Quebec Region

January 21, 2016
Mont-Joli, Qc

Chairperson: Stéphane Plourde

Context

The Estuary and northern Gulf of St. Lawrence are divided in four shrimp fishing areas (SFA): Estuary (SFA 12), Sept-Iles (SFA 10), Anticosti (SFA 9) and Esquiman (SFA 8). Shrimp fishing is regulated by a number of management measures, including the setting of total allowable catches (TAC) in the four areas.

The key elements for the establishment of a precautionary approach (PA) were adopted in 2012. Reference points were determined and guidelines have been established to determine harvest based on the stock status main indicator and its position relative to healthy, cautious and critical zone classification.

Objectives

Provide scientific advice for the management of Northern Shrimp stocks in the Estuary and Gulf of St. Lawrence (SFA 8, 9, 10 and 12) for the 2014 fishing season. This advice shall include:

- Description of the biology of Gulf of St. Lawrence Northern shrimp and its distribution;
- A summary of oceanographic conditions in the Gulf;
- Analysis of commercial fishery data including landings, effort, catch per unit of effort and data from the commercial sampling program;
- Data analysis of the DFO research surveys in August in the estuary and northern Gulf.
- Update of the main stocks status indicator.
- A recommendation on harvest according to PA guidelines for the 2016 fishing season.
- Comment the outlook for stock abundance.
- Estimate by-catches (among others, Redfish, Turbot, Northern Cod and Capelin) during the directed fishery on Northern Shrimp.
- Identification and prioritization of research projects to be considered for the future.

Expected Publications

- CSAS Science Advisory Report on Estuary and Gulf of St. Lawrence shrimp.
- CSAS Research documents
- CSAS Proceedings summarizing discussions.

Participation

- Fisheries and Oceans Canada (DFO) (Science, and Ecosystems and Fisheries Management sectors)
- Fishing industry
- Provincial representatives
- Aboriginal Communities / Organizations

APPENDIX 3 – STRATEGIC RESEARCH PLAN

DFO's contribution to the Northern Shrimp strategic research plan

Topic A. Shrimp productivity and sustainable harvesting

Sub-topic A1. The abundance of shrimp stocks in the Estuary and Gulf

- Status assessment of shrimp stocks by continued monitoring activities intended to calculate stock status indicators and determine the appropriate fishery catch shares consistent with the precautionary approach adopted in 2012 – DFO (Core Program)

Sub-topic A2. The trophic relationships between shrimp and its predators

- Description of the general structure, the trophic interactions and the effects of predation on vertebrate and invertebrate communities of the ecosystem by a mass-balance model using inverse methodology for the Estuary and northern Gulf of St. Lawrence for the period of 2011 to 2014 – DFO (Core Program) - C. Savenkoff et al.

Sub-topic A3. Environmental factors influencing shrimp productivity

- Status assessment of the physical and biochemical oceanographic environment of the Gulf of St. Lawrence by continuing the Atlantic Zone Monitoring Program to detect, monitor and foresee changes in productivity and marine environment status – DFO (Core Program)
- Assessment of the northern shrimp's physiological response to climate change and variability – DFO (Science Program – International Governance Strategy, 2011–2014) – P. Ouellet, D. Chabot, D. Orr; P. Calosi (University of Plymouth, UK).
- Vulnerability assessment of key commercial species (species selected based on their role in Northern Shrimp–Greenland Halibut trophic interactions) to climate change – DFO (Aquatic Climate Change Adaptation Services Program, 2013–2016). – C. Savenkoff, H. Bourdages, P. Galbraith, R. Larocque, M. Castonguay, J. Chassé, S. Dumont and D. Lemelin, S. Vaz (IFREMER, France).
- Assessment of synergic effects of various environmental stressors combined with acidification on the physiology, growth and survival of invertebrates that are harvested commercially in the St. Lawrence – DFO (Strategic Program for Ecosystem-Based Research and Advice 2014–2017) – D. Chabot and M. Starr.

Topic B. The impacts of the fishery on the ecosystem

Sub-topic B1. Vulnerable benthic habitats and communities

- Study of the distribution, spatial structure, reproduction, ecosystem function and vulnerability to trawling of sea pen fields in the Gulf of St. Lawrence in support of the "Eastern Canadian Coral and Sponge Conservation Strategy" – DFO (Strategic Program for Ecosystem-Based Research and Advice 2014–2017) – B. Sainte-Marie, H. Bourdages, C. Couillard, R. Larocque, C. Savenkoff, M. Ouellet, G. H. Tremblay, S. Cadieux.

Sub-topic B2. Species not targeted by the fishery

- Assessment of the significance of shrimpers' bycatch by analyzing data from the At-Sea Observer Program activity monitoring – DFO (Core Program)

- Evaluation of the impact of shrimpers' bycatch by performing a risk analysis for cod, Greenland halibut and redfish – DFO (Fisheries Science Collaborative Program) – H. Bourdages, C. Brassard, B. Morin (DFO), J.-P. Couillard, Association des capitaines propriétaires de Gaspésie (ACPG) and J. Lanteigne, Association des crevettiers acadiens du Golfe (ACAG).